Melicoccus bijugatus Jacq. Quenepa

Sapindaceae Soapberry family

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Melicoccus bijugatus Jacq., also known as quenepa, mamón (Spanish), genip (English), quenette (French), and by many other common names *(13, 21)*, is native to northern South America and is cultivated and naturalized widely throughout the tropics. Quenepa is a beautiful tree (fig. 1) that is planted for urban shade and for the tasty fruit it bears. The wood is useful for furniture and trim, but supplies are limited.

HABITAT

Native and Naturalized Range

The original range of quenepa was apparently in Colombia, Venezuela, and the Guayanas (fig. 2) *(10)*. It has become naturalized from cultivation throughout the West Indies, Mexico, Central America, much of tropical South America, and the Galapagos Islands *(11)*. Quenepa has been a part of the flora of the Caribbean islands for centuries *(10)* and may have been brought to some of the islands by indigenous peoples in pre-Columbian times. The species has also been introduced in Hawaii and the Old World tropics *(11, 13, 16, 18)*. Quenepa is also grown in warm temperate areas such as southern Florida and California *(3)*.

Climate

The two forest types—tropical dry transition to moist and tropical moist, according to Holdridge *(7)* —in Venezuela where quenepa reportedly grows naturally receive 900 to 2600 mm of precipitation and have 3 to 5 rainless months annually *(25)*. The mean annual temperature in the native range varies from about 25 to 27 °C, depending on elevation; there is little variation in month-to-month averages *(6)*. Mean annual temperatures throughout the naturalized range may be somewhat lower and have a wider summer to winter variation. The species will tolerate light frosts *(3)*.

Soils and Topography

Quenepa is not very demanding of soil quality, although it grows best on moist, fertile sites. Soils having a pH as high as 8.0 and as low as about 5.5 are acceptable. Quenepa trees grow in clays, loams, sands, and soft, porous limestone, provided the soils are well drained *(15)*. One of the reasons that the species is popular as an urban ornamental is that it will grow reasonably well in partially compacted fill dirt.

Quenepa grows naturally from near sea level to an elevation of about 1,000 m in Colombia *(13)*. Hills, flats, and river bottoms are all colonized.

Associated Forest Cover

Quenepa was noted on the island of St. John, U.S. Virgin Islands, in association with *Maytenus laevigata* (Vahl) Griseb. ex Eggers, *Guapira fragans* (Dum.-Cours.) Little, *Ocotea coriacea* (Sw.) Britton, *Sabinia florida* (Vhal) DC., *Inga fagifolia* (L.) Willd., *Bursera simaruba* (L.) Sarg., *Tabebuia heterophylla* (DC.) Britton, *Andira inermis* (W. Wright) HBK., and *Spondias mombin* L. *(24)*. On the island of St. Eustatius, Netherlands Antilles, quenepa was noted

Figure 1.—*Clump of young quenepa* (Melicoccus bijugatus) *trees growing in Puerto Rico.*

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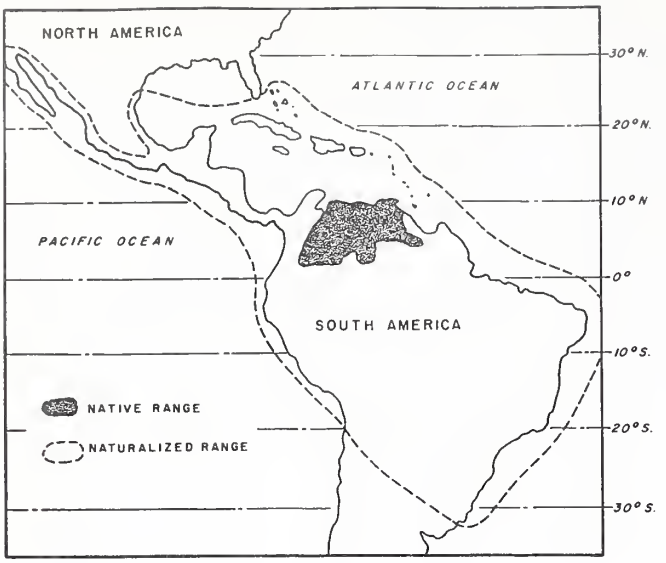

Figure 2.—*Approximate native and naturalized ranges of quenepa* (Melicoccus bijugatus) *trees in the Neotropics.*

as a minor component of the canopy layer of dry forest on a moderately steep, rocky site. The other species noted were *Pisonia subcordata* Sw., *B. simaruba* (L.) Sarg., *P. fragrans* Dumont-Cours, *Capparis indica* (L.) Fawc. & Rendle, *T. heterophylla* (DC.) Britton, and *Malpighia emarginata* Sessé & Moc. ex DC. *(23)*. Natural forest in the Cañón de Cauca in Colombia supports quenepa in association with *Inga* spp., *Ceiba pentandra* Gaertn., *Astronium graveolens* Jacq., *Hymenaea courbaril* L., *Erythrina glauca* Willd., *Anacardium occidentale* L., *T. pentaphylla* Heml., *Acrocomia antioquensis* Posada-Arango, *S. mombin* L., and many other species *(5)*.

LIFE HISTORY

Reproduction and Early Growth

Flowering and Fruiting.—The small, fragrant, greenish-white flowers are borne in clusters (panicled) at the ends of branches *(11)*. Flowers are mostly of one sex on individual trees (dioecious) but also can be bisexual (monoecious). Flowering in Puerto Rico proceeds from April to June, and fruits mature from June to September *(11)*. Fruits reportedly mature in September and October in Trinidad *(15)*. The fruits (drupes), which grow in clusters, have a green or greenish-yellow, leathery exocarp (outside). They contain one or occasionally two large seeds, each covered by fibers, and a salmon-colored, gelatinous layer (the edible portion).

Seed Production and Dissemination.—A sample of 60 air-dried, cleaned seeds from Puerto Rico averaged 2.64 ± 0.07 g per seed or 379 seeds per kilogram (author, personal observation). The fruiting of quenepa is apparently more regular in dry zones along streams or in moist coves than on exposed hillsides or in higher rainfall zones (author, personal observation). Fruit and seed production begins in 7 to 10 years from seed and in 4 to 5 years in vegetatively propagated stock *(16)*. Most seeds fall under the parent tree. Distribution of naturalized trees (along roads, trails, and near old farmsteads), suggests that humans are the major long-distance dispersers in Puerto Rico (author, personal observation). Dispersal by birds and bats is suggested for Trinidad and Tobago *(15)*.

Seedling Development.—In a test in Puerto Rico, first germination of untreated seeds occurred 28 days after sowing and continued for 2 months; 63 percent of the seeds germinated. Germination is hypogeous. The newly emerging shoot elongates about 10 cm before spreading the first leaves. Quenepa seedlings develop slowly. A group of seedlings grown in pots in Puerto Rico averaged just 39 cm in height 18 months after sowing (author, personal observation). The species is apparently difficult to transplant *(2)*, which probably means that bare-root stock and wildlings are prone to high mortality. Potted seedlings are transplanted successfully into moist ground.

Initial spacing of plantations will depend on intended use. If timber is the sole product, which is unlikely, an initial spacing of about 3 by 3 m will promote natural pruning and longer merchantable boles. If both fruit and timber are the objective, a 3- by 3-m spacing should be followed by heavy thinnings after the merchantable bole has been set. For fruit production only, wide initial spacing (6 by 6 m or more) and top pruning are advisable to force a low crown. In any case, weeding for 2 or 3 years will be required to get the seedlings above grass and brush competition. Direct seeding could work, provided the seedspots are weeded frequently for a least 2 years.

Vegetative Reproduction.—Young trees coppice when cut. Selected strains of quenepa can be propagated by layering and grafting onto ordinary rootstalks *(16)*. Successful rooting of cuttings has not been documented.

Sapling and Pole Stage to Maturity

Growth and Yield.—Quenepa has a reputation for slow growth, although there is little documentation of growth rates. Thirteen trees from all crown classes in a subtropical moist forest in St. John, U.S. Virgin Islands, grew an average of only 0.09 cm/yr in diameter *(24)*. Under favorable conditions, trees of the species can exceed 30 m in height and 1 m in diameter *(1, 14)*. The largest quenepa tree known to the author in Puerto Rico measures 1 m in diameter and 24 m in height. Open grown trees apparently increase about 1 cm/yr in diameter and for the first 40 years or so, about 0.5 m/yr in height.

Rooting Habit.—Seedlings rapidly develop a long, sparsely branched taproot that extends down until it encounters an impermeable layer or anaerobic conditions. An extensive lateral root system develops as the trees age (author, personal observation).

Reaction to Competition.—Quenepa is intolerant of shade *(15)*. Seedlings can survive under light shade but must have full or nearly full overhead sun to progress to a dominant position. Although quenepa grows well in moist forest areas, its relative growth rate is too slow to compete with the faster growing mesic species. Although never very abundant in natural forests, quenepa competes best on the wetter microsites of dry forests and in the transition be-

tween dry and moist forests. Quenepa is apparently favored by disturbance; trees most frequently gain a dominant canopy position in dry and moist secondary forests in mid-succession. Naturally regenerated trees are common at the fringes of farmsteads and along fencerows and roadsides—in places where livestock were excluded during the establishment period.

Damaging Agents.—Quenepa wood is reportedly susceptible to attack by the West Indies dry-wood termite, *Cryptotermes brevis* (Walker) *(19)*. The wet-wood termite, *Nasutitermes costalis* (Holmgren), constructs covered runways up quenepa trunks *(17)* to feed on dead limbs and twigs. Felled trees in Puerto Rico were attacked by ambrosia beetles (author, personal observation); these may belong to one of the three species of Coleoptera that quenepa is known to be susceptible to *(17)*. Quenepa wood is not resistant to decay *(11)*.

SPECIAL USES

The principal benefit of quenepa is the fruit it produces. The flavor of the fruits is sweet-tart; for want of a better comparison, it has been likened to that of green seedless grapes. Quenepa fruits are harvested and sold in clusters; the demand usually exceeds the supply in Puerto Rico. People eat them by biting off the exocarp and sucking the pulp away from the seed. There is danger in letting small children eat them; the seeds are said to cause occasional choking deaths.

Analysis of the fruit mesocarp (edible portion) in Colombia revealed that it is 77 percent water and contains 73 kcal/100 g. The mesocarp also contains 1 percent protein, 0.2 percent fat, 19 percent carbohydrates, 2 percent fiber, and 0.4 percent ash. The vitamin and mineral nutrient contents are also given *(22)*. Another analysis of the fruit pulp yields data similar in many respects: 69 percent water, 2 percent fiber, 9 percent ash, 0.7 percent N, 0.4 percent Ca, and 100 g of the pulp contain 50 mg P, 10 mg ascorbic acid, 0.2 mg carotin, 0.8 mg niacin, and 0.02 mg thiamin *(10)*.

The fruit is used in preparing fruit juice, alcoholic drinks, and jellies *(16, 22)*. The roasted seeds are also eaten. This food is particularly important to South American Indians in the Orinoco region who prepare it during shortages of cassava *(20)*. Quenepa gives a heavy but short-term flow of nectar that is converted by bees into a dark honey *(4)*.

The foliage of quenepa may contain useful biologically active chemicals. A tea made from the leaves is used in the Dominican Republic to reduce fevers *(10)*. The leaves reportedly kill fleas *(19)* and repel sandflies *(9)*.

Quenepa, an evergreen with a clean, pleasing form, is popular as a shade and ornamental tree in tropical America. It tolerates poor soils, requires little maintenance, and, under the right conditions, yields significant amounts of fruit. Naturally occurring trees along fencerows are regularly used as living fenceposts.

The wood of quenepa is pale yellow to pale chestnut in color with a pronounced fine grain pattern. The heartwood and sapwood are not very distinct. Samples of heartwood from one tree in Puerto Rico had an average specific gravity of 0.79 g/cm^3 (author, personal observation). The wood is hard and coarse-textured but is easily sawn and planed. Because of the wood's general lack of durability, interior applications are recommended. Quenepa wood is used to a limited extent for furniture, cabinetry, trim, and turnery items. Supplies are too limited for the wood to be of major commercial importance *(21)*. Quenepa wood is also used for charcoal and firewood *(19)*.

GENETICS

The only other member of the genus is *Melicoccus lepidopetanus* Radlk., a similar tree with edible fruit that grows in Bolivia, Paraguay, and northern Argentina *(8, 12)*. Superior clones of quenepa have been selected that have golf ball-sized fruits, rich flavor, and freestone flesh (personal communication with Francisco Watlinton-Linares, consultant, Santurce, Puerto Rico).

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